Technical Report No. 36

FOURTH PROGRESS REPORT AND BUDGET PROPOSAL FOR FY 1975

Compiled and edited by

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ISLAND ECOSYSTEMS IRP

U. S. International Biological Program

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ABSTRACT

This document is the fourth annual progress report of the ISLAND ECOSYSTEMS STABILITY AND EVOLUTION Subprogram of the U. S. International Biological Program (IBP). It covers the period from February 1973 through February 1974.

During the fourth year, the Subprogram has completed a majority of its field studies and begun the preparation of a draft synthesis volume.

This report discusses the scientific objectives which are proposed for the terminal year of funding, details the general plan by which these objectives will be met, and highlights some of the scientific accomplishments which have been recognized. A revised and detailed plan for the presentation of the synthesis results is included, as are compilations of the Contribution Numbers, Technical Reports, and Student Dissertations and Theses.

BUDGET ENDORSEMENT

In accordance with the planned completion of the Island Ecosystems IRP, we are submitting our budget for the final year of our 5-year program. The budget request for FY 75 (September 1, 1974 to August 31, 1975) amounts to $256,464.

We request that this sum be made available in two separate institutional grants -- one to the University of Hawaii, the other to the Bishop Museum -- as detailed at the end of this report (Chapter 6).

Respectfully submitted,

University of Hawaii

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Director

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1. INTRODUCTION

This progress report briefly highlights some of the past accomplishments of the Island Ecosystems Integrated Research Program (IRP). It also proposes that funding be granted for an additional year during which this research effort will be concluded. The primary intent of this year of funding will be to allow for the completion of the final synthesis volume and the publication of individual research reports. In addition, it will provide support for a few studies for which the collection of longer-term data are important and it will assist in the process of making an orderly transition of some component studies to other sources of support.

Our program was launched in September 1970 with four long-term objectives in mind:

1. To study the factors affecting speciation.
2. To study the stability and fragility of Hawaiian ecosystems.
3. To find biomathematical relationships in Hawaiian ecosystems.
4. To determine the rate of evolution and factors affecting Hawaiian ecosystems.

These objectives will be pursued beyond the time-limits of our present project. However, the five-year project will permit us to answer at least certain aspects of these long-term objectives by case examples. To this end we have limited our current objectives to a hierarchical subset of the long-term objectives as follows:

1. To demonstrate the spatial distribution and integration of island biota by a case example of a mountain transect.
2. To elucidate temporal variations in island ecosystems by case examples.
3. To describe the community structure and niche differentiation in island ecosystems by a case example of a native montane rain forest and other selected tropical ecosystems.
4. To present the results obtained thus far on within-species variation as related to island ecosystem parameters.

This subset of the long-term objectives has become the basis of our present synthesis activity for IBP. Plans are underway to enlarge the scope of these objectives to comparisons between different islands and island groups.

This report is being kept as brief as possible because all the Project participants are deeply involved in the preparation of the Preliminary Synthesis Volume.

2. BRIEF HISTORY OF THE ISLAND ECOSYSTEMS IRP

The Island Ecosystems Integrated Research Project (IRP) is currently in its fourth year of operation; funding of this research program was initiated on September 1, 1970. The funding requested by this proposal will allow the completion of five years of research of the planned five-year project.

Several major reports document the progress of this research program:

(1) The foundation-data for the study areas are available in Doty and Mueller-Dombois (1966, Atlas for Bioecology Studies in Hawaii Volcanoes National Park. College of Trop. Agric., Hawaii Agric. Expt. Sta., Miscell. Publication 89, 507 p.).

(2) The first few months (to December 1970) of research progress are given in Technical Report No. 1.

(3) The period from January 1971 to January 1972 is summarized in Technical Report No. 2.

(4) The next period, extending until March 1973, is contained in Technical Report No. 21.

(5) A summary of the highlights of the entire program, including the latest year until the present writing, in February 1974, is included as part of this report. The full presentation of the research results, however, is currently being prepared for draft presentation in November 1974 and a revised version is planned for publishing during 1975.

The scope of the research is summarized in Table 2.1.

Table 2.1. Total funding in relation to number of faculty collaborators supported.

	FISCAL YEAR					
	1	2	3	4	5	
	70-71	71-72	72-73	73-74	74-75	
Total funding	$239,700	$328,472	$348,200	$308,319	$256,464	proposed
No. of faculty collaborators	20	23	27	26	22	

3. OBJECTIVES OF YEAR 5 OF THE STUDY

There are two general areas into which the scientific objectives of this terminal phase of the Island Ecosystems IRP may be grouped; the Synthesis Activities and the Field Activities. For convenience, these have been further subdivided into seven Tasks. The budgets (Chapter 6) have been organized to reflect this Task subdivision.

SYNTHESIS ACTIVITIES

The scientific objectives of this terminal phase of the Island Ecosystems IRP are primarily oriented toward the synthesis of data and conceptualizations which have been derived from the previous phases of this project. The specific objectives are as follows:

TASK 1: Publication and Report Production.

A. The support of the facilities to successfully complete the preparation of the final synthesis volume is required. The draft of the synthesis of the Island Ecosystems IRP is currently being produced as Technical Report entitled "Integrated Island Ecosystems Ecology." A draft outline of the contents of this volume has been produced and is reproduced in this Report as Appendix I. Introductory descriptions for each section have been prepared (Technical Report No. 21) and are available for a general (although necessarily preliminary) view of each part of this synthesis. The draft version is expected to be completed by November 1974. To provide an analysis of the synthesis topics which fully utilizes the data which have been obtained during the project, it will be necessary to revise and expand the draft synthesis volume. It is this latter activity which is being proposed here. There are

several specific synthesis aspects which will be examined during the revision phase; these include:

i. Additional synthesis (i.e., higher level synthesis) of topics which were not originally available for synthesis will be undertaken. Specific topics might include the mutual consideration of the distribution and abundance of predators and prey or herbivores and their food resources.

ii. There will be some studies for which additional confirmation data will have been obtained. These studies are discussed under point (3) below. These data will be included in the analyses which will provide for a more substantive discussion of the scientific problems being examined.

B. The activities associated with the preparation of the draft synthesis volume will preclude the support of all of the publications which will result from the component studies of the Island Ecosystems IRP during the current funding year. In order that the necessary Technical Reports are produced (see Appendix III for a current listing of numbers) and manuscripts are prepared for external publication (Current Contributions are listed in Appendix II), it will be necessary to maintain an appropriate technical staff and have funds available for the report associated expenses.

TASK 2: Office Management.

The maintenance of the IBP office to support the management functions of the Project is very important. This office will continue to serve as the center for the coordination of the synthesis and field activities.

TASK 3: Data Processing and Facilitation.

It is expected that the need for centralized computer assistance for the reduction of data and the production of computer generated output, such as tables and graphs, will continue through the remainder of the Project. During this final phase, attention will be given to the full documentation of the data-bank procedures, including the computer programs, and the archiving of data sets. This will be done so that future investigations will have ready access to the data collected by this Project.

TASK 4: Scientific Meetings

The participation of Project personnel at scientific meetings is an important aspect of the synthesis activities. This task recognizes the need for such involvement (see phasing diagram, Chapter 4).

FIELD ACTIVITIES

The field activities which are proposed here in a general way will provide continuation support for the component subprojects. The particular studies have been described in detail elsewhere (Tech. Rept. No. 2).

TASK 5: Confirmation Data Collection.

The results of the draft synthesis efforts are expected to produce the need for some specific "confirmation" studies. These studies are intended to provide the specific validation of hypotheses which arise during the syntheses activities. This is a usual occurrence in research, but is expected to be particularly important as cross-study integration is attempted. It is not possible, at the time of this writing, to anticipate these specific needs; what limited funds are available for these tasks will be carefully released to obtain their maximum benefit.

TASK 6: Field Site Maintenance.

In order that the Confirmation Data Collection and Longer-term Monitoring studies be continued on the Island Ecosystems research sites, the field support facilities will have to be maintained, at least at a minimal level. This includes the rental of the IBP cabin, maintenance of the vehicles, and employment of the site manager. This is considered to be important for the continuity which may be established with the proposed permanent research facility for Hawaii Volcanoes National Park.

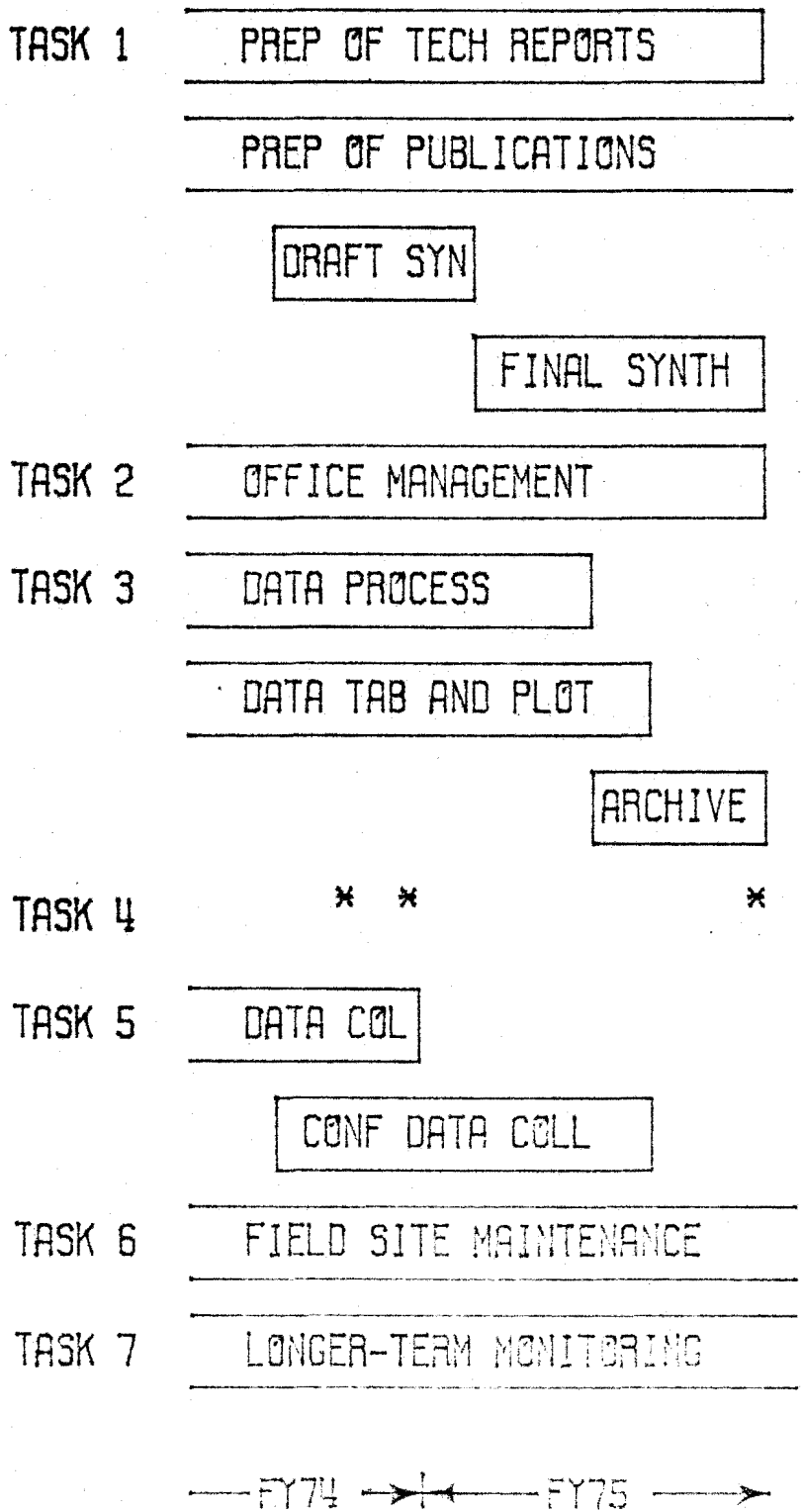
TASK 7: Longer-term Data Collection.

Ecosystem studies contain some components which require longer-term data for an adequate analysis of the system. Climate data, phenological data, responses of vegetation in exclosure studies and as a result of disturbance are only a few such examples from this Project. The entire Island Ecosystems IRP will have been funded for 4 years at the end of the current funding period (September 1974). With the necessary start-up time, the effective sampling period has been less than this; an additional year of sampling, especially through the winter wet season is very important.

In addition, many of the research components of the Island Ecosystems IRP will be phased over to other sources of research support. In order that the transitions are orderly and that the appropriate continuity in data collection is maintained, some interim support is necessary.

4. PHASING DIAGRAM

This diagram shows the periods over which each task (as described in Chapter 3) or subtask is active. The time scale extends from the present date to the end of FY 75 (August 31, 1975). Open ended blocks at the end of the time scale represent tasks which are expected to continue under other sources of support.



5. HIGHLIGHTS OF THE PREVIOUS RESEARCH

There have been many scientific accomplishments resulting from the research activities of the Island Ecosystems IRP*. What follows is a list of some of the highlights of these accomplishments.

The highlights are given here in a brief form. Where more detailed elaboration is available, such as in a publication or Technical Report, the appropriate citation is made. Additional documentation will be available in the Synthesis Volume and other reports currently being prepared.

There is no particular importance to the order in which these highlights are presented here, nor has it been possible to elaborate all of the highlights at this time.

1. A level of generalization has been produced for data synthesis of island ecosystems to test important ecological similarities and differences to mainland ecosystems and other island ecosystems. This is the structural and functional group concept. (Tech. Rept. No. 19)
2. Conceptual advances have been made in analyzing space-time data by computer methods through our ecosystem transect approach.
3. The first set of quantitative evaluations are available for the introduced herbivore effects on the vegetation in the Hawaiian Islands. (Ecology 54(4):870; Tech. Rept. No. 3, 13 and 15)
4. The first set of quantitative primary succession data in Hawaii on new volcanic materials have been accumulated on the same sites in permanent quadrats over a nine year period. (Tech. Rept. No. 10)
5. The quantitative impact and physiological behavior of introduced grasses in island habitats has been documented. (Trop Ecol. 14(1):1-18; Tech. Rept. No. 4 and 15)

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*A list of the component subprojects is given in Table 5.1

TABLE 5.1 COMPONENT SUBPROJECTS.

PROJ CODE	PROJECT TITLE	INVESTIGATORS
B1	VEGETATION-ENVIRONMENT CORRELATION STUDIES	MUELLER-DOMBOIS, WIRAWAN
B2	STUDIES OF PLANT TO PLANT INTERACTIONS: STUDIES OF DISTRIBUTIONAL DYNAMICS	MUELLER-DOMBOIS, SPATZ, MAKA
B3	PHENOLOGICAL AND GROWTH STUDIES, 1972	LAMOUREUX
B4	LIFE HISTORY STUDIES OF IMPORTANT PLANTS: ANGIOSPERMS	MUELLER-DOMBOIS, COORAY
B5	FERN STUDY (CIBOTIUM SPP., THE HAWAIIAN TREE FERNS)	FRIEND
B2	THE COMPETITIVE CAPACITY OF HAWAIIAN TREE FERNS (IN CONJUNCTION WITH SUBPROJECT B5)	BECKER
B6	GENECOLOGICAL STUDIES OF METROSIDEROS	LAMOUREUX, CORN
B7	THE ECOLOGICAL ROLE OF SOIL ALGAE	DOTY
B8	THE OCCURENCE AND ECOLOGICAL ROLES OF SOIL FUNGI ASSOCIATED WITH ACACIA KOA ON MAUNA LOA TRANSECT	BAKER, M.STONER, D. STONER
B8	THE ROLES OF FUNGI IN ISLAND ECOSYSTEMS	M.STONER, BAKER
C1	BIOSYSTEMATICS OF HAWAIIAN DIPTERA FAUNA IN NATIVE FOREST LITTER-DISTRIBUTION, ABUNDANCE AND FACTORS RESPONSIBLE FOR VARIATION	HARDY
C2	THE ECOLOGY OF HAWAIIAN SCIARIDAE	STEFFAN
C3	CERAMBYCID-BORER STUDY	GRESSITT, DAVIS, SAMUELSON
C4	PHYTOPHAGOUS INSECTS- SAP & SEED FEEDERS (HETEROPTERA)	GAGNE
C5	THE EFFECTS OF SAP-SUCKING HOMOPTERA ON HAWAIIAN ECOSYSTEMS	BEARDSLEY, LEEPER
C6	FAUNAL RESEARCH ON METROSIDEROS	HARAMOTO, NISHIDA NAKAHARA
C9	SOIL & DUFF INHABITING ARTHROPODS, VERTEBRATE ECTOPARASITES, & CAVERNICOLES IN LAVA TUBES	RADOVSKY, TENORIO, HOWARTH
C11	INSECT INTERFERENCE IN THE REPRODUCTIVE CYCLE OF COMMUNITY STRUCTURE-FORMING PLANTS, PARTICULARLY SEED FEEDERS	MITCHELL, BRENNAN
C12	THE EFFECTS OF DISEASES OF INSECTS IN HAWAIIAN ECOSYSTEMS	M.CONANT
D1	LIFE HISTORY AND EVOLUTION OF HAWAIIAN HONEYCREEPERS	BERGER, MACMILLAN CARPENTER, S.CONANT
D1	GRADIENT ANALYSIS OF THE AVIAN COMMUNITY	BERGER, S.CONANT
D2	SMALL MAMMALS	TOMICH
D3	THE PHYSIOLOGICAL ECOLOGY OF SOME TERRESTRIAL HAWAIIAN BIRDS & MAMMALS	MACMILLAN, CARPENTER
E1	GENETIC VARIATIONS OF HAWAIIAN DROSOPHILA IMMIGRANS	PAIK, SUNG
E1	CONTINUING STUDIES ON HAWAIIAN DROSOPHILA SPECIES	CARSON
E1	THE ELECTROPHORETIC VARIATION IN ACACIA KOA	STEINER
E2	CLIMATE STUDIES	BRIDGES
E2	DATA PROCESSING	BRIDGES, CAREY

MARCH 1974

6. Advances have been made in the causal analysis of the versatile reproductive behavior of one of the most important island tree species, Acacia koa. (Tech. Rept. No. 17)

7. A mathematical evaluation of spatial distribution patterns of all plant species has been made in a superficially homogeneous insular tropical rain forest. (Tech. Rept. No. 33)

8. A method has been developed to determine the age-structure of tropical tree species that lack annual growth rings.

9. A technique has been developed for producing stability-fragility indices for island ecosystems and applied to several data sets. (For example, Tech. Rept. No. 34)

10. Experimental evidence was obtained linking soil algae to soil arthopods in food-chain relationships.

11. Advances were made in the causal analysis of soil algal distribution along a mountain gradient of island ecosystems.

12. Breeding seasons were determined for 11 species of Hawaiian forest birds. Before initiation of this Project there existed virtually no data of this nature.

13. A unique nesting behavior was discovered in the Hawaiian amakihi. All published records of passerine birds indicate spring nesting, a time when daylengths are increasing. In this Hawaiian passerine, nest building begins in mid-October when daylengths decrease.

14. Honeycreepers were reared in captivity for the first time. Before, it was generally accepted that these birds could reproduce only when left undisturbed in their natural habitat.

15. Significant bioenergetic and behavioral differences were discovered in island as compared to continental passerine species. (Tech. Rept. No. 9 and 33)

16. Some ecologically wide ranging native island birds species (Hawaii elepaio, amakihi, akiapolaau) were discovered. Most previous bird range studies on islands indicated adaptation to narrow ecological amplitudes.

17. Life cycle data on three exotic bird species were obtained for the first time (common Indian mynah, Japanese white-eye and house finch).

18. A synthesis of all data on Hawaiian birds was published in book form. (Berger, A. J. 1972. Hawaiian Birdlife. Univ. Press of Hawaii, Honolulu, 270 p.)

19. Data bank procedures were developed which provide more efficient organization and greatly facilitate data analyses.

20. Numerous general utility programs have been implemented in a time-sharing environment which will assist in other ecosystem studies.

21. A computer-plotter program has been developed which has achieved very wide acceptance in many disciplines. (Tech. Rept. No. 29)

22. Techniques have been adapted which greatly simplify the procedures of data conversion to machine-readable records.

23. An unusual degree of polymorphism has been discovered in Plastosciara perniciosa (Diptera: Sciaridae) involving two widely divergent morphotypes of both adult males and adult females. This discovery provides a unique opportunity for investigating the intrinsic and extrinsic mechanisms governing polymorphism and behavior. (Science 182:1265-66).

24. The first study has been made of the seasonal abundance of sciarid species (Diptera) with correlated weather data and vegetation analyses. (Tech. Rept. No. 7)

25. The seasonal abundance and spatial distribution of sciarid species (Diptera) has been documented for an altitudinal transect.

26. The first quantitative analysis of rodent ectoparasites has been performed for an extended altitudinal transect, with correlations evaluated for host species, age, sex, and breeding condition; other ectoparasite species present; substrate

and vegetation; and season, as well as altitude. (Partial results for IV. Intern. Congr. Acarology, August 1974)

27. A rigid altitudinal limitation has been documented in the distribution (only below 4000 ft.) of two species of fur mites (Listrophorus musculus on Mus musculus and Listrophoroides expansus on two Rattus spp.). This is the first known instance of this group of permanent parasites of homeotherms being thus restricted apparently by climatic factors. (For IV. Intern. Congr. Acrology, August 1974)

28. A distinctive new species of fur mite (Listrophorus) has been discovered which produces mange in cats on two Hawaiian islands, the second record of Listrophoroidea on felids and the first records on the domestic cat. This is also notable as the second instance of a new Listrophorus species discovered in Hawaii on a common cosmopolitan host introduced to these islands less than 200 years previously. (J. Med. Entomol. 11, in press)

29. An extensive series of parasites has been collected from endemic Hawaiian birds, particularly from the endemic Drepanididae. Some of the ectoparasites are undescribed and others were previously known only from early material now inadequate for critical study. The special significance of this collection is that it will allow the analysis of the origin and interrelationship of endemic parasites on avian hosts (particularly based at this time on host-specific Mallophaga).

30. The first extensive and critical collection of soil-faunal communities has been made in Hawaii; the analysis of these data is underway.

31. The altitudinal and vegetational distribution patterns have been documented for the major species among the soil and litter arthropods, with data supporting a greater incursion of introduced soil arthropods (compared to foliar arthropods) into relatively intact native vegetational communities at intermediate and high altitudes.

32. A restricted cryptozoic fauna has been found at high temperatures in close proximity to volcanic steam vents (fumaroles): This fauna differs in composition from

the soil fauna of the surrounding areas.

33. The spatial distribution of introduced rodents has been analyzed along an altitudinal gradient and as related to the patterns of vegetation.

34. The seasonal food preferences of introduced rodents have been correlated with the phenology of rain forest vegetation.

35. The annual population cycle of "commensal" introduced rodents has been documented where these animals occur under wild conditions.

36. The resident fungi of the phylloplane, the litter zone, and the soil were analyzed in relation to three endemic vascular plants (Metrosideros collina, Acacia koa, Cheirodendron trigynum) along an altitudinal gradient from 2,250 to 8,250 feet.

37. An evaluation has been made of the relationships between substrate anatomy and the abundance of transient fungi,

38. Affinities were determined for fungi as they occur on three endemic vascular plant phylloplanes.

39. Levels of genetic variability in four species of endemic Drosophila have been found to be very high. Thus, the capacity of local island populations to change genetically does not seem to be basically different from continental populations.

40. Measurements on populations of endemic Drosophila in some environments (Kilauea and Olaa Forest) have been found to be balanced and show little temporal variation in abundance.

41. In other environments (Mauna Loa Strip Road), shifting gene frequencies in endemic Drosophila were observed. This suggests that the populations shift genetically in response to environmental stresses.

42. An exotic species, Drosophila immigrans, has been shown to have genetic differentiation along the Mauna Loa Strip Road. This reflects evolutionary change in a recently-introduced species.

43. Two very closely related and ecologically similar species of Hawaiian Drosophila

have been found to coexist without interbreeding in Olaa Forest. Fully fertile hybrids have nevertheless been obtained in the laboratory, suggesting that their isolation in nature is ethological and of recent origin.

44. One of the common endemic Drosophila found in Olaa Forest displays striking chromosomal differences between high and low altitudes (4400' and 2000'). These appear to vary clinally, suggesting ecotypic differentiation.

45. Cold-temperature and wind-tunnel tests with seeds of the major native Hawaiian tree species Metrosideros collina indicate as probable a long-distance transfer through the troposphere for this species. (Tech. Rept. No. 6)

46. Altitudinal ecotypes were discovered in the ecologically wide-ranging Metrosideros tree through progeny tests. (Tech. Rept. No. 18, Am. J. Bot. 60:991-1002).

47. The impact of a newly established exotic herbivore insect (Psylla uncatoides) on specific elements of the endemic flora (Acacia koa and Acacia koaia) has been determined to significantly reduce their vigor. The correlation of the population fluctuations of this insect with season and altitude (on the Mauna Loa Strip Road) has been established.

48. The efficacy of biological control of a psyllid, Psylla uncatoides, has been studied. The positive growth response of previously affected trees in one community (Acacia koaia scrub, leeward Kohala Mts.) has been observed after the introduction of the control species.

49. Some 15 species of Plagithmysus (cerambycids), endemic to Hawaii and including one not previously decribed, were monitored along the Mauna Loa transect with data on abundance, altitudinal distribution, larval boring habits, and condition of host. (Tech. Rept. No. 5)

50. A promising, new sampling procedure was tested quantifying host biomass replaced by larval workings of cerambycids. This procedure utilized diagrams of cross-sections of host trunks and branches, with the resultant data analyzed by computer.

51. The first faunistic survey was made of Hawaiian lava tubes. (Tech. Rept. No. 16; Pac. Ins. 15:139-151)

52. The first specialized cave animals known in Hawaii were discovered. These are among the first known from any oceanic island and among the first terrestrial cave animals from the tropics. (Science 175:325-326)

53. The discovery was made that cave animals travel by underground routes and can colonize suitable lava tubes in less than 100 years from nearby older lava tubes. Therefore, a cave-adapted fauna can be anticipated also in other volcanic areas. Lava tubes are a new type of cave for biospeleological research, which has traditionally involved limestone caves.

54. Hawaiian cave animals have been found not to be related to continental cave organisms but to Hawaii's native biota, and offer prime examples of adaptive shift on oceanic islands. This confirms the functional group approach to ecosystem analysis.

55. Cave adaptation has been evaluated for different islands, indicating that it has occurred independently on at least 3 of the Hawaiian Islands. (Tech. Rept. No. 16)

56. The first food web analysis of the Hawaiian cave ecosystem has been performed. Plant roots were found to be an important energy source in Hawaiian caves. (Tech. Rept. No. 16; Pac. Insects 15:139-151) Subsequent workers are now reporting that tree roots may also be important in continental caves.

57. Detailed observations were made on the biology of 6 species of cave arthropods.

58. Preliminary data have been obtained on the cave environment allowing the division of the cave into climatic zones. When refined this may provide insight into the distribution of cave organisms on a world-wide basis.

59. A large diverse terrestrial amphipod fauna in the Hawaiian Islands was discovered. To date 30 n. spp., which is nearly one quarter of the total world's fauna, have been found (Bousfield and Howarth, in press). This search was initiated to find the surface relatives of a remarkable new cave amphipod.

60. Bat skeletons, possibly the Hawaiian bat, Lasiurus cinereus semotus, were discovered in a lava tube near timberline on Mauna Loa. L. cinereus is a forest bat, and this discovery that it also roosts in caves is noteworthy.

61. Subfossil rail bones were discovered in a lava tube on Maui. This is the first rail recorded from Maui.

62. The first biological and geological notes were made for more than 75 caves in Hawaii, including the survey of the longest unbroken lava tube in the world (10 km passage) and the discovery of the first limestone cave in Hawaii.

63. Studies have been carried out on the distribution and abundance of five species of native psyllids (Homptera: Psyllidae) which are sap-suckers on Metrosideros. Correlation has been established between the reproductive biology of the psyllids and the growth of Metrosideros.

64. Psyllids were observed to diapause, an unusual phenomenon for an endemic insect of the tropics. Nymphs were observed to diapause for as long as eleven months.

65. The insects associated with Metrosideros collina blossoms were measured from five sites. This established new host records and allowed the relationships between peak periods of blossoming and insect activity to be determined.

66. The successful colonization of high altitude ecosystems by Drosophila immigrans and D. simulans was quantitatively measured in relation to climatological factors.

67. The chromosomal variability of Drosophila immigrans has been measured in relation to the altitudinal gradient on Mauna Loa and compared to sites on other islands in Hawaii and continental areas.

68. Shade adaptation of both gametophytes and sporophytes of tree fern (Cibotium) were found to be brought about by their low physiological plasticity in response to the light environment. This was discovered from the saturating light intensity, the initial slope of the curve relating photosynthesis to light intensity, leaf morphology and chlorophyll contents.

69. A systematic method of cloning Metrosideros collina by airlayering has been developed, with a number of clones presently growing together in one common environment. This will allow a quantitative distinction between the environmental and genetical parameters causing the morphological differences.

70. It was established that for the two major Hawaiian tree species, Metrosideros seeds require light to germinate, whereas Acacia koa seeds do not. (Tech. Rept. No. 17)

71. The first measurements of bioenergetic capacities of Hawaiian honeycreepers (Aves: Drepanididae) have been made and compared with mainland equivalents, showing lack of high temperature tolerance and inability to affect evaporative cooling during heat stress. (Tech. Rept. No. 9; Condor, Spring 1974)

72. There has been a preliminary verification of a unique foraging strategy of nectivorous honeycreepers during the summer. This foraging is neither territorial nor in flocks, and yet allows for efficient exploitation of ohia nectar, a renewable resource. (Tech. Rept. No. 33)

73. Experiments have demonstrated the relative importance of self-pollination, insect pollination, and bird pollination of ohia, and their influences on the success of seed set.

74. A two-phase approach to the determination of the spatial distribution of fungal decomposers and other fungal associates in the rhizosphere of the A_1 soil horizon has been developed and used around the dominant vascular plants along the Mauna Loa transect.

75. The first quantitative and comprehensive determination (including biomass) has been made of foliar arthropod populations along an altitudinal transect, from sea level to near tree line, on a high oceanic island. This utilizes a non-persistent insecticide in a standardized new sampling method, with particular reference to Metrosideros collina and Acacia koa. Intensive comparable studies in a mid-elevation

rain forest have been made.

76. The first evaluation has been made of the distribution and impact of introduced predators, particularly the ants which are of major importance in this respect, on native arthropods in Hawaii.

6. BUDGETS

The budgets for FY 75 (September 1, 1974 to August 31, 1975) are presented in two forms. The first lists, in detail, the budgets requested to support each TASK (as described in Chapter 3). In these budgets, the requests for both institutions have been combined.

The separate institutional budgets are shown as the second form of the budgets. Cost-sharing items for the University of Hawaii budget are shown on this second budget form. The Bishop Museum will cost-share in accordance with current National Science Foundation Policy.

Proposed IBP Grant Budget, 05 Year, 1974-75

BUDGET SUMMARY

		Requested from NSF	Institution Contribution
I.	UNIVERSITY OF HAWAII	$156,458	$11,279
II.	B. P. BISHOP MUSEUM	$100,003	*
	TOTAL REQUESTED	$256,461	$11,279

* THE BISHOP MUSEUM WILL COST-SHARE IN ACCORDANCE WITH CURRENT NATIONAL SCIENCE FOUNDATION POLICY (NSF NOTICE NO. 31, DATED 9-3-70).

Proposed IBP Grant Budget, 05 Year, 1974-75
University of Hawaii

BUDGET SUMMARY

		NSF Funded Man Months Cal/Acad/Sum		UH Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A.	SALARIES AND WAGES					
	1. Principal Investigators & Faculty Associates					
	A. J. Berger (CI-5)		2	1	5910	2955
	K. W. Bridges (CI-3)	9	1		15170	
	C. H. Lamoureux (CI-5)		1	1	2335	2245
	D. Mueller-Dombois (CI-5)		2	1	4318	2076
	Y. K. Paik (CI-5)		1	1	2245	2245
	Subtotal				29978	9521
	2. Other Personnel					
	8 Grad. Assts.	45			38406	
	1 Technical Assistant	12			8448	
	1 Student help				9000	
	Subtotal				55854	
	Total Salaries and Wages				85832	9521
B.	FRINGE BENEFITS				6400	1758
	Total Salaries, Wages and Fringe Benefits				92232	11279
C.	PERMANENT EQUIPMENT				0	
D.	EXPENDABLE SUPPLIES AND EQUIPMENT				3750	
E.	TRAVEL					
	1. Domestic					
	59 Interisland round trips (Honolulu-Hilo)				5900	
	1 Round trip (California-Hawaii)				230	
	2 Mainland roundtrips				1200	
	Total Travel				7330	
F.	PUBLICATION COSTS				3000	
G.	OTHER COSTS					
	Photography				300	
	Xerox, duplication, printing				2500	
	Mailing				400	
	Telephone				300	
	Computer time				3000	
	Connect charges				1750	
	Keypunch rental				500	
	Disk rental				384	
	Terminal rental				1200	
	Consultant				2330	
	Cabin rental				1200	
	Total Other Costs				13864	

		PROPOSED	
		NSF	UH
H.	TOTAL DIRECT COSTS	120176	11279
I.	INDIRECT COSTS		
	1. On-campus 46.00% of Salaries & Wages ($62,143)	28585	
	2. Off-campus 32.49% of Salaries & Wages ($23,689)	7697	
	Subtotal	36282	
J.	TOTAL COSTS	$156458	$11279

Proposed IBP Grant Budget, 05 Year, 1974-75
B. P. Bishop Museum

BUDGET SUMMARY

		NSF Funded Man Months Cal/Acad/Sum	BM Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED BM
A.	SALARIES AND WAGES				
	1. Principal Investigators & Faculty Associates				
	W. Gagne	12		10000	
	J. L. Gressitt	.5		1222	
	F. Howarth	12		10000	
	F. J. Radovsky	1.5		3333	
	W. Steffan	1 1		3674	
	Subtotal			28229	
	2. Other Personnel				
	L. Araki	12		7700	
	V. Carey	12		8200	
	J. Jacobi	12		6500	
	Technical Assistants	15		6300	
	Subtotal			28700	
	Total Salaries and Wages			56929	
B.	FRINGE BENEFITS			5123	
	Total Salaries, Wages and Fringe Benefits			62052	
C.	PERMANENT EQUIPMENT			0	
D.	EXPENDABLE SUPPLIES AND EQUIPMENT			300	
E.	TRAVEL				
	1. Domestic				
	11 interisland round trips (Honolulu-Hilo)			1100	
	1 mainland round trip			600	
	Subtotal			1700	
	2. International				
	1 Round trip (New Guinea-Honolulu)			1300	
	Total Travel			3000	
F.	PUBLICATION COSTS			200	
G.	OTHER COSTS				
	Mailing			50	
	Vehicle Maintenance			2500	
	Total Other Costs			2550	
H.	TOTAL DIRECT COSTS			68102	
I.	INDIRECT COSTS				
	1. On-campus 58.97% of Salaries and Wages ($50,429)			29738	
	2. Off-campus 33.29% of Salaries and Wages ($6500)			2163	
	Total Indirect Costs			31901	
J.	TOTAL COSTS			$100003	

TASK 1: PUBLICATION AND REPORT PRODUCTION

	NSF Funded Man Months Cal/Acad/Sum	UH Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A. SALARIES AND WAGES				
1. Principal Investigator & Faculty Associates				
A. J. Berger (CI-5)		1 1	2955	2955
K. W. Bridges (CI-3)		1	1517	
D. Mueller-Dombois (CI-5)		1 1	2159	2076
Y. K. Paik (CI-5)		1 1	2245	2245
W. Gagne*	9		7500	
J. L. Gressitt*		.5	1222	
F. Howarth*	6		5000	
F. Radovsky*		1	2222	
W. Steffan*		1	1837	
Subtotal			26657	7276
2. Other Personnel				
R. G. Cooray (G2-3R)	4		3512	
R. E. Becker (G2-3R)	3		2634	
C. A. Corn (G2-3R)	4		3512	
L. L. McGurk (G1-3R)	4		3264	
B. M. Brennan (G2-3R)	4		3512	
Grad. Asst. (Berger) (G1-1R)	4		3024	
J. R. Leeper (G2-3R)	4		3512	
Typist			7500	
Subtotal			30470	
Total Salaries and Wages			57127	7276
B. FRINGE BENEFITS				
University of Hawaii			1293	1342
Bishop Museum (9% of $17,781)			1600	
Total Salaries, Wages and Fringe Benefits			60020	8618
C. PERMANENT EQUIPMENT			0	
D. EXPENDABLE SUPPLIES AND EQUIPMENT			1500	
E. TRAVEL				
1. Domestic (2 round trips to meet with publishers of Synthesis Volume)			1200	
2. Foreign (1 round trip to New Guinea-Honolulu) (BM)			1300	
Total Travel			2500	
F. PUBLICATION COSTS				
Reprints costs (Bishop Museum = $200)			3200	
G. OTHER COSTS				
Photography			300	
Xeroxing, duplication, printing			2000	
Mailing (Bishop Museum = $50)			300	
Total Other Costs			2600	

		PROPOSED	
		NSF	UH
H.	TOTAL DIRECT COSTS	69820	8618
I.	INDIRECT COSTS		
	University of Hawaii (46.00% of $39,346)	18099	
	Bishop Museum (58.97% of $17,781)	10485	
	Total Indirect Costs	28584	
J.	TOTAL COSTS	$98404	$8618

* Bishop Museum Personnel

TASK 2: OFFICE MANAGEMENT

	NSF Funded Man Months Cal/Acad/Sum	UH Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A. SALARIES AND WAGES				
1. Principal Investigator and Faculty Associates				
D. Mueller-Dombois (CI-5)				
K. Bridges (CI-3)	4		6068	
Subtotal			6068	
2. Other Personnel				
L. Araki*	12		7700	
Subtotal			7700	
Total Salaries and Wages			13768	
B. FRINGE BENEFITS				
University of Hawaii			1189	
Bishop Museum (9% of $7700)			693	
Subtotal			1882	
Total Salaries, Wages and Fringe Benefits			15650	
C. PERMANENT EQUIPMENT			0	
D. EXPENDABLE SUPPLIES AND EQUIPMENT			500	
E. TRAVEL			0	
F. PUBLICATION COSTS			0	
G. OTHER COSTS				
Xeroxing, duplicating and printing			500	
Mailing			150	
Telephone			300	
Total Other Costs			950	
H. TOTAL DIRECT COSTS			17100	
I. INDIRECT COSTS				
1. On-campus (UH) 46.00% of Salaries & Wages ($6068)			2791	
2. On-campus (BM) 58.97% of Salaries & Wages ($7700)			4541	
Total Indirect Costs			7332	
J. TOTAL COSTS			$24432	

* Bishop Museum Personnel

TASK 3: DATA PROCESSING AND FACILITATION

	NSF Funded Man Months Cal/Acad/Sum	UH Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A. SALARIES AND WAGES				
1. Principal Investigator & Faculty Associate				
K. W. Bridges (CI-3)	5		7585	
Subtotal			7585	
2. Other Personnel				
V. Carey *	12		8200	
Subtotal			8200	
Total Salaries & Wages			15785	
B. FRINGE BENEFITS				
University of Hawaii			1455	
Bishop Museum (9% of $8200)			738	
Subtotal			2193	
Total Salaries, Wages and Fringe Benefits			17978	
C. PERMANENT EQUIPMENT			0	
D. EXPENDABLE SUPPLIES AND EQUIPMENT			1000	
E. TRAVEL			0	
F. PUBLICATION COSTS			0	
G. OTHER COSTS				
Computer time			3000	
Connect charges (900 hr at $3/hr)			1750	
Keypunch rental (1/2 cost = $42/mo)			500	
Disk rental ($32/mo)			384	
Terminal rental ($100/mo)			1200	
Total Other Costs			6834	
H. TOTAL DIRECT COSTS			25812	
I. INDIRECT COSTS				
1. On-campus (UH) 46.00% of Salaries & Wages ($7585)			3489	
2. On-campus (BM) 58.97% of Salaries & Wages ($8200)			4836	
Total Indirect Costs			8325	
J. TOTAL COSTS			$34137	

* Bishop Museum Personnel

TASK 4: SCIENTIFIC MEETINGS

		NSF Funded Man Months Cal/Acad/Sum	UH Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A.	SALARIES AND WAGES				
	1. Principal Investigator & Faculty Associates			0	
B.	FRINGE BENEFITS			0	
	Total Salaries, Wages and Fringe Benefits			0	
C.	PERMANENT EQUIPMENT			0	
D.	EXPENDABLE SUPPLIES AND EQUIPMENT			0	
E.	TRAVEL				
	1. Domestic 1 round trip to mainland			600	
F.	PUBLICATION COSTS			0	
G.	OTHER COSTS			0	
H.	TOTAL DIRECT COSTS			600	
I.	INDIRECT COSTS			0	
J.	TOTAL COSTS			$600	

TASK 5: CONFIRMATION DATA COLLECTION

	NSF Funded Man Months Cal/Acad/Sum	UH Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A. SALARIES AND WAGES				
1. Principal Investigators & Faculty Associates				
A. J. Berger (CI-5)	1		2955	
F. J. Radovsky, Entomologist*	.5		1111	
W. A. Steffan, Entomologist*	1		1837	
W. Gagne, Assoc. Entomologist*	3		2500	
F. Howarth, Assoc. Entom.*	6		5000	
Subtotal			13403	
2. Other Personnel				
R.G. Cooray (G2-3R)	2		1756	
C. Corn (G2-3R)	2		1756	
L. McGurk (G1-3R)	2		1632	
B. Brennan (G2-3R)	2		1756	
Grad. Asst. (G1-1R)	2		1512	
J. Leeper (G2-3R)	2		1756	
Technical Assistants*	15		6300	
Subtotal			16468	
Total Salaries & Wages			29871	
B. FRINGE BENEFITS				
University of Hawaii			502	
Bishop Museum (9% of $16748)			1507	
Subtotal			2009	
Total Salaries, Wages and Fringe Benefits			31880	
C. PERMANENT EQUIPMENT			0	
D. EXPENDABLE SUPPLIES AND EQUIPMENT (BM = $300)			1050	
E. TRAVEL				
1. Domestic				
59 round trips (Honolulu-Hilo) (BM = $1100)			5900	
1 round trip (Calif.-Hawaii)			230	
Total Travel			6130	
F. PUBLICATION COSTS			0	
G. OTHER COSTS				
Consultant			2330	
H. TOTAL DIRECT COSTS			41390	
I. INDIRECT COSTS				
1. Off-campus (UH) 32.49% of $13,123			4264	
2. On-campus (BM) 58.97% of $16,748			9876	
Total Indirect Costs			14140	
J. TOTAL COSTS			$55530	

* Bishop Museum Personnel

TASK 6: FIELD SITE MAINTENANCE

		NSF Funded Man Months Cal/Acad/Sum	UH Funded Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A.	SALARIES AND WAGES				
	1. Principal Investigator and Faculty Associate				
	2. Other Personnel				
	Technician (J. Jacobi)*	12		6500	
	Subtotal			6500	
	Total Salaries and Wages			6500	
B.	FRINGE BENEFITS				
	Bishop Museum (9% of $6500)			585	
	Total Salaries, Wages and Fringe Benefits			7085	
C.	PERMANENT EQUIPMENT			0	
D.	EXPENDABLE SUPPLIES AND EQUIPMENT			0	
E.	TRAVEL			0	
F.	PUBLICATION COSTS			0	
G.	OTHER COSTS				
	Cabin rental (incl. telephone, electricity, etc.)			1200	
	Vehicle maintenance			2500	
	Total Other Costs			3700	
H.	TOTAL DIRECT COSTS			10785	
I.	INDIRECT COSTS				
	1. Off-campus (BM) 33.29% of Salaries & Wages ($6500)			2163	
J.	TOTAL COSTS			$12948	

* Bishop Museum personnel

TASK 7: LONGER-TERM MONITORING

		NSF Funding Man Months Cal/Acad/Sum	UH Funding Man Months Cal/Acad/Sum	PROPOSED NSF	PROPOSED UH
A.	SALARIES AND WAGES				
	1. Principal Investigator and Faculty Associates				
	K. Bridges (CI-3)				
	D. Mueller-Dombois (CI-5)	1		2159	
	C. H. Lamoureux (CI-5)	1	1	2335	2245
	Subtotal			4494	2245
	2. Other Personnel				
	Technician (G. Murakami)X1·2R	12		8448	
	N. Wirawan (G2-3R)	6		5268	
	Student help			1500	
	Subtotal			15216	
	Total Salaries & Wages			19710	2245
B.	FRINGE BENEFITS			1961	416
	Total Salaries, Wages and Fringe Benefits			21671	2661
C.	PERMANENT EQUIPMENT			0	
D.	EXPENDABLE SUPPLIES AND EQUIPMENT			0	
E.	TRAVEL				
	1. Domestic				
	11 Round trips to field site			1100	
F.	PUBLICATION COSTS			0	
G.	OTHER COSTS			0	
H.	TOTAL DIRECT COSTS			22771	2661
I.	INDIRECT COSTS				
	1. Off-campus (UH) 32.49% of Salaries & Wages ($10,566)			3433	
	2. On-campus (UH) 46.00% of Salaries & Wages ($9,144)			4206	
	Total Indirect Costs			7639	
J.	TOTAL COSTS			$30410	$2661

APPENDIX I. DRAFT CHAPTER OUTLINE
(Individual chapter titles and authorships are tentative)

INTEGRATED ISLAND ECOSYSTEM ECOLOGY

PART I. INTRODUCTORY SURVEY (D. Mueller-Dombois)

1. Scope and objectives
2. General characteristics of island ecosystems
3. Organism groups studied in the program
4. Organization of integrated research
5. The research area

PART II. SPATIAL DISTRIBUTION OF ISLAND BIOTA ALONG AN ALTITUDINAL GRADIENT

6. Introduction (D. Mueller-Dombois)

6.1 Selection of Mauna Loa Transect as a case example of a major environmental gradient

6.2 General description of the transect

6.3 Hypotheses of species distribution

6.4 Experimental design and sampling

6.5 Data processing

7. Altitudinal distribution of site factors (K. W. Bridges and D. Mueller-Dombois)
8. Altitudinal distribution of vascular plants and tree communities (D. Mueller-Dombois and G. Spatz)
9. Altitudinal variation in Metrosideros along the Mauna Loa Transect (Carolyn Corn)
10. Phenological patterns along the Mauna Loa Transect (C. H. Lamoureux)
11. Altitudinal distribution of rodents (P. Q. Tomich)
12. Altitudinal distribution of ectoparasites of rodents (F. J. Radovsky and JoAnn Tenorio)

13. Altitudinal distribution of birds (A. J. Berger)

14. Altitudinal distribution of introduced Drosophila species (Y. K. Paik)

15. Altitudinal distribution of selected detritophages (Sciaridae) (W. A. Steffan)

16. Altitudinal distribution of insects in Acacia koa tree communities

16.1 General canopy feeders (W. Gagne)

16.2 Introduced psyllids (J. W. Beardsley and J. R. Leeper)

17. Altitudinal distribution of insects in Metrosideros tree communities

17.1 General canopy feeders (W. Gagne)

17.2 Blossom feeders (W. C. Mitchell)

17.3 Native psyllids (T. Nishida, F. Haramoto and L. Nakahara)

18. Altitudinal distribution of wood-boring Cerambycid beetles (J. L. Gressitt and G. A. Samuelson)

19. Altitudinal distribution of soil- and litter-fungi (M. F. Stoner and G. E. Baker)

20. Altitudinal distribution of soil algae (M. S. Doty and L. L. McGurk)

21. Altitudinal distribution of soil arthropods (F. J. Radovsky and JoAnn Tenorio)

22. Altitudinal distribution of litter-inhabiting Diptera (D. E. Hardy)

23. Spatial integration of organism groups along the Mauna Loa Transect (D. Mueller-Dombois)

PART III. TEMPORAL RELATIONSHIPS OF ISLAND BIOTA

SECTION A. SEASONAL PATTERNS

24. The general nature of climatological seasonality on the IBP transect (K. W. Bridges + ?)

25. The general problems of recognizing seasonal trends in organisms (K. W. Bridges + ?)

26. The phenology of selected plant species; some preliminary observations (C. H. Lamoureux)

27. The temporal pattern of change in koa diameter measurements (G. Spatz and D. Mueller-Dombois)

28. Temporal patterns in the soil algae (M. S. Doty)

29. The temporal pattern of abundance in some introduced Drosophila species. (Y. K. Paik)

30. The temporal distribution of native Psyllid abundance on Metrosideros collina (L. Nakahara, F. Haramoto, T. Nishida)

31. The temporal occurrence of introduced Psyllids on Acacia koa (J. W. Beardsley and J. R. Leeper)

32. The temporal pattern of the abundance of Hawaiian Sciaridae (W. A. Steffan)

33. The temporal abundance of blossom feeding insects (W. Mitchell)

34. The pattern of abundance in soil arthropods (F. Radovsky and J. Tenorio)

35. Evidence for the absence of seasonality in wood-boring Cerambycid beetles (J. L. Gressitt, C. J. Davis, G. A. Samuelson)

36. Cave-inhabiting insects; a lack of seasonality (F. Howarth)

37. Seasonal trends in the abundance and behavior of birds (A. J. Berger and S. Conant)

38. Seasonal trends in the abundance and reproductive status of rodents (P. Q. Tomich)

39. Interspecific relationships as related to temporal patterns

40. Temporal phasing differences between endemic and exotic species

41. The implication of temporal patterns on the stability of Island Ecosystems

SECTION B. SUCCESSIONAL PATTERNS

42. Succession in plant communities; replacement by exotic species and recovery trends of native species (D. Mueller-Dombois and G. Spatz)

43. Succession in caves (F. Howarth)

PART IV. COMMUNITY STRUCTURE AND NICHE DIFFERENTIATION

SECTION A. INTRODUCTION

44. General historical background and orientation to current studies (A. J. Berger and F. J. Radovsky)

SECTION B. COMMUNITY STRUCTURE AND NICHE DIFFERENTIATION IN THE KILAUEA FOREST

45. General description of the Kilauea Forest, including its place among Hawaiian ecosystems (A. J. Berger, D. Mueller-Dombois, and F. J. Radovsky)

46. Forest layer analysis of the plant community in the Kilauea Forest (R. Cooray)

47. Quantitative analysis of plant species in the Kilauea Forest (R. Cooray and J. Maka)

48. Tree population structure in the Kilauea Forest (R. Cooray)

49. Age structure analysis of Acacia koa in the Kilauea Forest (G. Spatz and D. Mueller-Dombois)

50. Spatial variation analysis of the plant community in the Kilauea Forest (J. Maka)

51. Spatial and temporal structure of bird populations in the Kilauea Forest (A. J. Berger and S. Conant)

52. Spatial and temporal structure of mammal populations in the Kilauea Forest (P. Q. Tomich)

53. Spatial and temporal structure of arthropod populations in the Kilauea Forest (W. Gagne, J. L. Gressitt and F. J. Radovsky)

54. Niche differentiation in the Kilauea Forest Community (A. J. Berger, D. Mueller-Dombois, and F. J. Radovsky)

SECTION C. COMMUNITY STRUCTURE AND NICHE DIFFERENTIATION IN LAVA TUBES

55. Physical parameters, biotic elements, food webs, niche differentiation, and other evolutionary implications in lava tube communities (F. G. Howarth)

SECTION D. EVOLUTION AND MODIFICATION OF BIOTIC COMMUNITIES

56. Insular vs. continental communities (A. J. Berger and F. J. Radovsky)

57. Impact of exotic vertebrates (D. Mueller-Dombois and P. Q. Tomich)

58. Impact of exotic invertebrates (J. W. Beardsley and W. Gagne)

59. Functional aspects of consumer relations (K. Bridges and R. E. MacMillen)

60. Diversity and stability (K. Bridges, W. Gagne and C. H. Lamoureux)

PART V. GENETIC VARIATION WITHIN ISLAND SPECIES

SECTION A. INTRODUCTION

61. Intraspecific genetic variability

62. Ecological genetics and microevolution

SECTION B. MATERIAL AND METHODS

63. Endemic and exotic Drosophila (H. L. Carson)

63.1 Protein variability: gel electrophoresis (W. Steiner and W. Johnston)

63.2 Chromosome inversion variability (H. L. Carson and Y. K. Paik)

64. Metrosideros collina (C. Corn)

64.1 Inference from phenotypes (C. Corn)

64.2 Transplanting and cloning (C. Corn)

64.3 Gel electrophoresis (W. Steiner)

SECTION C. RESULTS

65. Endemic Drosophila

65.1 Protein variability in D. mimica (W. Steiner)

65.2 Protein variability in D. engyochracea (W. Steiner)

65.3 Comparisons and contrasts between D. mimica and D. engyochracea (W. Steiner)

65.4 Genetic variability in a montane rain forest: D. silvestris at Kilauea Forest (W. Johnston and E. M. Craddock)

66. Exotic Drosophila

66.1 Chromosomal variability in D. immigrans on the Mauna Loa Strip (Y. Paik)

66.2 Relation to ecosystem parameters (Y. Paik)

66.3 Comparisons with other populations, island and continental (Y. Paik)

66.4 Protein variability in D. simulans and D. immigrans (W. Steiner and K. C. Sung)

67. Variation in Metrosideros collina (C. Corn)

SECTION D. GENERAL CONCLUSIONS (H. L. Carson)

68. The characteristics of insular species

69. Genetic variation in insular species

70. Speciating organisms: Are they the genetically dynamic elements in island ecosystems?

71. Non-speciating organisms: Are they the genetically stable elements in island ecosystems?

72. Evolution of adaptations vs. the evolution of species

APPENDIX II. CONTRIBUTION NUMBERS FOR THE ISLAND ECOSYSTEMS IRP

1. Howarth, F. G. 1971. Cavernicoles in lava tubes on the island of Hawaii. Science 175:325-326.

2. Mi, M. P., S. Yamashiro and D. Mueller-Dombois. 1972. Data storage and retrieval for the study of Hawaiian ecosystems. Proc. Fifth Hawaii Intern. Confer. on Systems Sciences. p. 243-245.

3. Gressitt, J. L. and C. J. Davis. 1971. New plagithmysines from Kauai, Molokai and Hawaii. Proc. Hawn. Ent. Soc. 21(1):67-77.

4. Gressitt, J. L. 1972. New plagithmysines from Molokai, Lanai and Maui. Pacific Insects 14(1):83-92.

5. Gressitt, J. L. and C. J. Davis. 1972. Seasonal occurrence of the Hawaiian Cerambycidae (Col.). Proc. Hawn. Ent. Soc. 21(2):213-221.

6. Spatz, GÜnter and D. Mueller-Dombois. 1973. The influence of feral goats on koa tree reproduction in Hawaii Volcanoes National Park. Ecology 54(4):870-876.

7. Mueller-Dombois, D. 1973. A non-adapted vegetation interferes with water removal in a tropical rain forest area in Hawaii. Tropical Ecology 14(1):1-18.

8. Corn, Carolyn. 1972. Seed dispersal methods in Hawaiian Metrosideros. In John A. Behnke, (ed.). Challenging Biological Problems. Oxford University Press, N. Y. 200 p.

9. Gressitt, J. L. 1972. New plagithmysines from West Maui (Col.: Cerambyc.). Pacific Insects 14(4):635-645.

10. Gressitt, J. L. and Clifton J. Davis. 1972. Seasonal occurrence and host-lists of Hawaiian Cerambycidae. Proc. of Hawn Ent. Soc. 21(3).

11. Fennah, R. G. 1973. The cavernicolous fauna of Hawaiian lava tubes. Part IV. Two new species of Oliarus (Fulgoroidae: Cixiidae). Pacific Insects 15(1): 181-184.

12. MacMillen, Richard E. In press. Bioenergetics of Hawaiian honeycreepers: the Amakihi (Loxops virens) and the Anianiau (L. parva). Condor.

13. Holbrook-Walker, S. and R. M. Lloyd. 1973. Reproductive biology and gametophyte morphology of the Hawaiian fern genus Sadleria (Blechnaceae) relative to habitat diversity and propensity for colonization. Bot. J. of the Linnean Society 67(2):157-174.

14. Steffan, Wallace. 1973. Ecological studies of Ctenosciara hawaiiensis (Hardy) (Diptera: Sciaridae). Pacific Insects 15(1):85-94.

15. Paik, Y. K. and Kee Chang Sung. In press. Ecogeographical variations of chromosomal polymorphism in Hawaiian populations of Drosophila immigrans. Jap. Jour. of Genetics.

16. Corn, Carolyn and William Hiesey. 1973. Altitudinal variation in Hawaiian Metrosideros. Amer. J. Bot. 60(10):991-1002.

17. Howarth, F. G. 1973. The cavernicolous fauna of Hawaiian lava tubes. Part I. Introduction. Pacific Insects 15(1):139-151.

18. Gertsch, Willis J. 1973. The cavernicolous fauna of Hawaiian lava tubes. Part III. Araneae (spiders). Pacific Insects 15(1):163-180.

19. Schultz, George A. 1973. The cavernicolous fauna of Hawaiian lava tubes. Part II. Isopoda (Crustacea). Pacific Insects 15(1):153-162.

20. Steffan, Wallace. In press. Redescription of Bradysia tritici and B. reynoldsi. Proc. of Hawn. Ent. Soc.

21. Gressitt, J. L. and C. J. Davis. In press. Two new plagithmysines from Maui and Hawaii (Col.:Cerambycidae). Proc. of Hawn. Ent. Soc.

22. Mueller-Dombois, D. In press. Some aspects of island ecosystems analysis. Chapter in Ecol. Series, Springer-Verlag ed. by Golley and Medina.

23. Hardy, D. Elmo and Mercedes D. Delfinado. In press. Flightless Dolichopodidae (Diptera) in Hawaii. Proc. of Hawn. Ent. Soc.

24. Steffan, Wallace. 1973. Notes on Hawaiian Sciaridae (Diptera) and description of two new species. Pacific Insects 15(3-4):353-361.

25. Bridges, Kent W. 1973. An examination of ecosystem stability using mini-computers. IEEE Region Six Conference Record 1973:8-11.

26. Mueller-Dombois, Dieter and Garrett A. Smathers. In press. Sukzession nach einem Vulkanausbruch auf der Insel Hawaii. Proceed. Symposium "Sukzessionsforschung", Rinteln, W. Germany, April 1973.

27. Paik, Y. K. and K. C. Sung. Variation of chromosomal inversion polymorphism in Hawaiian populations of Drosophila immigrans. 13th International Congress of Genetics, August 1973. Genetics 74(2):207-208.

28. Steffan, Wallace. In press. Laboratory studies and ecological notes on Hawaiian Sciaridae (Diptera). Pacific Insects.

29. Spatz, Günter. In press. Sekundär-Sukzession auf von Schweinen zerstörtem Grasland im Hawaii Volcanoes National Park, Hawaii. Proceed. Symposium "Sukzessionsforschung", Rinteln, W. Germany, April 1973.

30. Howarth, F., Bellinger, Peter and Kenneth A. Christianson. In press. Cavernicolous fauna of Hawaiian lava tubes. Part IV. Collembola. Pacific Insects.

31. Mueller-Dombois, Dieter and Günter Spatz. In press. The influence of feral goats on the lowland vegetation in Hawaii Volcanoes National Park. Phytocoenologia.

32. Steffan, Wallace. 1973. Polymorphism in Plastosciara perniciosa. Science 182:1265-1266.

33. Lloyd, Robert. Mating systems and genetic load in pioneer and non-pioneer Hawaiian Pteridophyta. Submitted for publication.

34. Gressitt, J. L. and C. J. Davis. In press. New plagithmysines from Kauai and West Maui (Col.: Cerambycidae). Proc. of Hawn. Ent. Soc.

35. Steffan, Wallace. In press. Morphological and behavioral polymorphism in Plastosciara perniciosa (Diptera: Sciaridae). Proc. Ent. Soc. of Washington.

36. Spatz, Günter and Dieter Mueller-Dombois. In press. Succession patterns after pig digging in grassland communities on Mauna Loa, Hawaii. Phytocoenologia.

37. Mueller-Dombois, Dieter and Günter Spatz. In press. Application of the relevé method to insular tropical vegetation for an environmental impact study. 90th Ann. for Braun-Blanquet book.

38. Smathers, Garrett A. and Dieter Mueller-Dombois. In press. Invasion and recovery of vegetation after a volcanic eruption in Hawaii. National Park Service Scientific Monograph Series Number 000, 1973.

39. Tenorio, JoAnn. A new species of Listrophorus (Acarina: Astigmata: Listrophoridae) from Felis catus in the Hawaiian Islands. Submitted for publication.

APPENDIX III. TECHNICAL REPORT NUMBERS FOR THE ISLAND ECOSYSTEMS IRP.

No. 1 Hawaii Terrestrial Biology Subprogram. First Progress Report and Second-Year Budget. D. Mueller-Dombois, ed. December 1970. 144 p.

No. 2 Island Ecosystems Stability and Evolution Subprogram. Second Progress Report and Third-Year Budget. D. Mueller-Dombois, ed. January 1972.

No. 3 The influence of feral goats on koa (Acacia koa Gray) reproduction in Hawaii Volcanoes National Park. G. Spatz and D. Mueller-Dombois. February 1972. 16 p.

No. 4 A non-adapted vegetation interferes with soil water removal in a tropical rain forest area in Hawaii. D. Mueller-Dombois. March 1972. 25 p.

No. 5 Seasonal occurrence and host-lists of Hawaiian Cerambycidae. J. L. Gressitt and C. J. Davis. April 1972. 34 p.

No. 6 Seed dispersal methods in Hawaiian Metrosideros. Carolyn Corn. August 1972. 19 p.

No. 7 Ecological studies of Ctenosciara hawaiiensis (Hardy) (Diptera: Sciaridae). W. A. Steffan. August 1972. 7 p.

No. 8 Birds of Hawaii Volcanoes National Park. A. J. Berger. August 1972. 49 p.

No. 9 Bioenergetics of Hawaiian honeycreepers: the Amakihi (Loxops virens) and the Anianiau (L. parva). R. E. MacMillen. August 1972. 14 p.

No. 10 Invasion and recovery of vegetation after a volcanic eruption in Hawaii. G. A. Smathers and D. Mueller-Dombois. September 1972. 172 p.

No. 11 Birds in the Kilauea Forest Reserve, a progress report. A. J. Berger. September 1972. 22 p.

No. 12 Ecogeographical variations of chromosomal pholymorphism in Hawaiian populations of Drosophila immigrans. Y. K. Paik and K. C. Sung. February 1973. 25 p.

No. 13 The influence of feral goats on the lowland vegetation in Hawaii Volcanoes National Park. D. Mueller-Dombois and G. Spatz. October 1972. 46 p.

No. 14 The influence of SO_2 fuming on the vegetation surrounding the Kahe Power Plant on Oahu, Hawaii. D. Mueller-Dombois and G. Spatz. October 1972. 12 p.

No. 15 Succession patterns after pig digging in grassland communities on Mauna Loa, Hawaii. G. Spatz and D. Mueller-Dombois. November 1972. 44 p.

No. 16 Ecological studies on Hawaiian lava tubes. F. G. Howarth. December 1972. 20 p.

No. 17 Some findings on vegetative and sexual reproduction of koa. Günter O. Spatz. February 1973. 45 p.

No. 18 Altitudinal ecotypes in Hawaiian Metrosideros. Carolyn Corn and William Hiesey. February 1973. 19 p.

No. 19 Some aspects of island ecosystems analysis. Dieter Mueller-Dombois. February 1973. 26 p.

No. 20 Flightless Dolichopodidae (Diptera) in Hawaii. D. Elmo Hardy and Mercedes D. Delfinado. February 1973. 8 p.

No. 21 Third Progress Report and Budget Proposal for FY 74 and FY 75. D. Mueller-Dombois and K. Bridges, eds. March 1973. 153 p.

No. 22 Supplement 1. The climate of the IBP sites on Mauna Loa, Hawaii. Kent W. Bridges and G. Virginia Carey. April 1973. 141 p.

No. 23 The bioecology of Psylla uncatoides in the Hawaii Volcanoes National Park and the Acacia koaia Sanctuary. John R. Leeper and J. W. Beardsley. April 1973. 13 p.

No. 24 Phenology and growth of Hawaiian plants, a preliminary report. Charles H. Lamoureux. June 1973. 62 p.

No. 25 Laboratory studies of Hawaiian Sciaridae (Diptera). Wallace A. Steffan. June 1973. 17 p.

No. 26 Natural area system development for the Pacific region, a concept and symposium. Dieter Mueller-Dombois. June 1973. 55 p.

No. 27 The growth and phenology of Metrosideros in Hawaii. John R. Porter. August 1973. 62 p.

No. 28 EZPLOT: A computer program which allows easy use of a line plotter. Kent W. Bridges. August 1973. 39 p.

No. 29 A reproductive biology and natural history of the Japanese white-eye (Zosterops japonica japonica) in urban Oahu. Sandra J. Guest. September 1973. 95 p.

No. 30 Techniques for electrophoresis of Hawaiian Drosophila. W. W. M. Steiner and W. E. Johnson. November 1973. 21 p.

No. 31 A mathematical approach to defining spatially recurring species groups in a montane rain forest on Mauna Loa, Hawaii. Jean E. Maka. December 1973. 112 p.

No. 32 The interception of fog and cloud water on windward Mauna Loa, Hawaii. James O. Juvik and Douglas J. Perreira. December 1973. 11 p.

No. 33 Interactions between Hawaiian honeycreepers and Metrosideros collina on the island of Hawaii. F. Lynn Carpenter and Richard E. MacMillen. December 1973. 23 p.

No. 34 Floristic and structural development of native dry forest stands at Mokuleia, N.W. Oahu. Nengah Wirawan. January 1974. 49 p.

No. 35 Genecological studies of Hawaiian ferns: reproductive biology of pioneer and non-pioneer species on the island of Hawaii. Robert M. Lloyd. February 1974. 29 p.

APPENDIX IV. STUDENT DISSERTATION AND THESIS TITLES

Theses prepared under partial support of the US/IBP ISLAND ECOSYSTEMS IRP. The titles and completion dates of expected theses are tentative. All programs are associated with the University of Hawaii unless otherwise noted.

Becker, R. E. The competitive capacity of Hawaiian tree ferns. Ph.D., expected June 1975.

Brennan, B. M. Production, release and bioassay of the sex attractant of the male southern green stink bug. Ph.D., expected December 1974.

Brown, William Y. Breeding biology and factors in breeding success of some tropical terns. Ph.D., May 1973.

Carson, Johnny L. Microbial ecology of Hawaiian Islands. Ph.D., expected 1975, University of North Carolina.

Conant, Michael. Nuclear polyhedrosis of Uresiphita polygonalis. M.S., expected December 1974.

Cooray, R. G. Tree population structure of a montane rain forest on Mauna Loa, Hawaii. M.S., expected June 1974.

Cooray, R. G. The impact of feral pigs on the Hawaiian rain forest. Ph.D., expected June 1976.

Corn, C. A. Variation of Hawaiian Metrosideros. Ph.D., expected August 1976.

Dunn, P. H. The ecology of filamentous heterotrophic microorganisms in subtropical and tropical marine psammen habitats. Ph.D., August 1973.

Eddinger, C. Robert. A study of the breeding biology of four species of Hawaiian honeycreepers (Drepanididae). Ph.D., December 1970.

Gagne, Wayne. Insular evolution and speciation of the genus Nesiomiris Kirkaldy (Heteroptera: Miridae) in the Hawaiian Islands. Ph.D., expected September 1974, University of California, Berkeley.

Guest, Sandra. Breeding biology of the Japanese White-eye (Zosterops japonica japonica). M. S., August 1973.

Hirai, Lawrence. Breeding biology of the house finch (Carpodacus mexicanus). M.S., expected August 1974.

Karganilla, Nelda. Edaphic algae of Hawaii Volcanoes National Park. M.S., August 1972.

Lee, B. K. H. Ecological and physiological studies of soil microfungi in Heeia mangrove swamp, Oahu, Hawaii. Ph.D., May 1971.

Leeper, John R. The bioecology and biological control of Psylla uncatoides (Fenis & Klyver) (Psyllidae: Homoptera) on Acacia koa in the Hawaii Volcanoes National Park and on Acacia koaia in the Kohala Mountains. Ph.D., expected June 1975.

Maka, Jean. A mathematical approach to defining spatially recurring species groups in a montane rain forest on Mauna Loa, Hawaii. M.S., December 1973.

McGurk, Linda-Lee. Algal distribution in Hawaii Volcanoes National Park in relation to various environmental factors. M.S., expected August 1974.

Meeker, Joseph A. Atichia in Hawaii. Ph.D., December 1973.

Nakahara, Larry. Distribution and abundance of psyllidae (Homoptera) on Metrosideros collina subsp. polymorpha (Gaud.) Rock in the Hawaii Volcanoes National Park. M.S., expected June 1974.

Porter, John R. The growth and phenology of Metrosideros in Hawaii. Ph.D., September 1972.

Smathers, G. A. Invasion, early succession and recovery of vegetation on the 1959 Kilauea volcanic surfaces, Hawaii Volcanoes National Park, Hawaii. Ph.D., August 1972.

Spatz, G. O. Ein Nutzungsvorschlag für die "Keauhou Ranch" auf Hawaii aus landwirtschaftlicher und ökologischer Sicht. Habilitation for professorship, November 1973, Tech. Univ., Munich.

Steiner, W. W. M. Population structure, desiccation resistance and genotype-environment interactions of biochemical polymorphism in Hawaiian Drosophilidae. Ph.D., expected August 1974.

Sung, Kee Chang. Selection of inversions in Hawaiian populations of Drosophila immigrans. Ph.D., expected June 1974.

Tenorio, J. Taxonomic and biological studies of Hawaiian Ephydridae (Diptera). Ph.D., May 1971.

Van Riper, Charles. Comparative breeding biology of four species of Hawaiian honeycreeper (Drepanididae) on the island of Hawaii. Ph.D., expected June 1975.

Wirawan, N. Floristic and structural development of native dry forest stands at Mokuleia, NW Oahu. M.S., May 1972.

Wirawan, N. Effect of vegetation cover on soil-water relations in a tropical rain forest area, Hawaii. Ph.D., expected September 1975.